

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC**

In the Matter of)	
)	
Expanding Flexible Use in Mid-Band)	GN Docket No. 17-183
Spectrum Between 3.7 and 24 GHz)	

COMMENTS OF ELEFANTE GROUP, INC.

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SUMMARY

Elefante Group, Inc. (“Elefante Group”), by its attorneys, hereby responds to the Commission’s Notice of Inquiry in the above-referenced proceeding by urging the Commission to implement regulatory frameworks to accommodate persistent stratospheric-based communications and infrastructure in the 17.8-24.0 GHz range where such stratospheric systems can operate compatibly with other permitted uses.¹ With the support of Lockheed Martin Corporation’s (“Lockheed Martin’s”) and drawing upon its many decades of experience with lighter-than-air platforms and communications systems, the Elefante Group airship platforms and communications payloads are being designed and developed to support high-density, high-frequency re-use terrestrial broadband communications and Internet of Things (“IoT”)-enabling solutions for the communications, government, institutional, and enterprise sectors. Elefante Group is looking to deploy its stratospheric communications systems commercially in the next four years to provide high-capacity and coverage solutions on a wholesale basis supporting 5G backhaul and fixed wireless broadband access in both rural and urban areas.

Persistent stratospheric solutions will be a key element of next generation wireless networks. Deployment of such systems will help achieve a host of Commission and Administration objectives, including private investment in high speed broadband communications infrastructure, closing the digital divide, densification and deployment of 4G, 5G, and IoT-enabling technologies, maximizing spectrum efficiency and band utilization, spectrum sharing, rapid deployment/restoration of communications capabilities enhancing public safety and disaster relief, and the creation of tens of thousands of American jobs.

¹ *Expanding Flexible Use in Mid-Band Spectrum between 3.7 and 24 GHz*, GN Docket No. 17-183, Notice of Inquiry, 32 FCC Rcd 6373 (rel. Aug. 3, 2017) (“*Notice*”).

Stratospheric communications systems offer comparative advantages relative to other delivery methods. Specifically, Elefante Group's stratospheric solution can offer spectrally efficient payloads with frequency reuse higher than other communications systems, but with the latency and greater link data rates comparable to ground-based systems. The beam sizes, number of beams and ability to customize the footprint relative to satellites allows Elefante Group's stratospheric solutions to target unserved and underserved areas with micro precision. Elefante Group's stratospheric platforms will have larger potential service areas than ground system base stations with minimal infrastructure requirements and with more efficient opportunities for maintenance, repair and replacement as part of regular, periodic platform switchover in a matter of months, rather than the years it would take to replace a ground-based network or a constellation of satellites. Finally, in contrast with ground-based communications systems and with possible advantages over satellite systems, stratospheric platform communications will support rapid deployment and restoration of communications capabilities at high capacities after natural and man-made disasters, enhancing public safety and disaster relief efforts.

Elefante Group has modeled the 5G backhaul and fixed broadband access needs and projects that serving these requirements will necessitate flexible deployment of more than 1 Tbps additional capacity per metro area. Based on significant analysis to date by Elefante Group, supported by Lockheed Martin, and their present understanding of how spectrum compatibility can be achieved in the bands they have been examining below 24 GHz, each airship platform will require, in an ideal deployment, use of at least 1.25 gigahertz of spectrum in each direction.

Elefante Group and Lockheed Martin continue to refine an innovative design that possesses exceptional flexibility and yields superior capacity while maximizing spectrum efficiency and frequency band utilization by a variety of users, including accommodation of the

communication requirements of incumbents. Elefante Group, based on considerable technical analyses performed in conjunction with Lockheed Martin, submits that the following spectrum bands under 24 GHz are the most promising to achieve all, or nearly all, of the platforms' communications requirements as part of an initial deployment by Elefante Group.

- 17.8-18.3 and 19.3-19.7 GHz would be highly suitable for customer terminal-to-platform links (uplinks) and 18.3-19.3 and 19.7-20.2 GHz are also candidates for uplinks.
- 22.5-23.6 GHz is Elefante Group's primary candidate for Platform-to-Customer terminal links (downlinks).

These bands offer the potential for a high degree of spectrum compatibility of nominally fixed stratospheric communications systems with incumbent users, be they terrestrial fixed services, satellite operations, inter-satellite links, Earth Exploration Satellite Service, or the space research service. Elefante Group, supported by Lockheed Martin, will continue to build upon their current spectrum compatibility analyses. The companies intend to provide additional status reports to the Commission on their efforts in the coming months, providing more details in support as they refine their proposals.

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Elefante Group, Inc. (“Elefante Group”), by its attorneys, hereby responds to the Commission’s Notice of Inquiry in the above-referenced proceeding by urging the Commission to implement regulatory frameworks to accommodate persistent stratospheric-based communications and infrastructure in those bands where they can operate compatibly with other permitted uses.²

I. OVERVIEW: THE OPPORTUNITIES FOR STRATOSPHERIC COMMUNICATIONS SYSTEMS

The Commission inquires whether there are spectrum bands between 3.7 and 24 GHz that were not discussed in the *Notice* that “present[] an opportunity for more intensive and efficient use of this spectrum.”³ In response, Elefante Group discusses herein its efforts, in collaboration with Lockheed Martin Corporation (“Lockheed Martin”), to design and develop (and ultimately deploy) stratospheric solutions on a shared basis in certain bands in the range 17.8-24.0 GHz. Elefante Group and Lockheed Martin are optimizing the Elefante Group persistent stratospheric system architecture, platforms, and payloads to derive additional uses of already utilized spectrum, thereby advancing another critical objective in this spectrum-hungry era by

² *Expanding Flexible Use in Mid-Band Spectrum between 3.7 and 24 GHz*, GN Docket No. 17-183, Notice of Inquiry, 32 FCC Rcd 6373 (rel. Aug. 3, 2017) (“*Notice*”).

³ *Id.* at ¶ 38.

maximizing spectrum utilization through spectral efficiency and well-planned spectrum sharing. Elefante Group, as described in more detail herein, is looking to deploy its stratospheric communications systems in the next four years to provide high-capacity and coverage solutions on a wholesale basis supporting 5G backhaul and fixed wireless broadband access. Stratospheric solutions can be a key element in the timely deployment of 5G, in rural as well as urban areas, and they also would advance many other Commission and Administration objectives.

Elefante Group applauds the Commission for commencing this Inquiry to explore potential opportunities for expanded flexible broadband use and innovative wireless solutions in the radiofrequency bands between 3.7 and 24 GHz. The Commission correctly observed in the *Notice* that “[w]ireless broadband – whether fixed or mobile, terrestrial or satellite – represents a critical component of economic growth, job creation, public safety, and global competitiveness.”⁴ Additionally, the prospect of more intensively utilizing our nation’s radio frequency resources through sound spectrum management that implements innovative regulatory frameworks that both are technology neutral and support efficient coordination among multiple delivery platforms drives investment and innovation. Elefante Group wholeheartedly supports forward-looking spectrum management initiatives that foster collaborative spectrum use by exploiting technologies and systems that permit more dynamic spectrum access in a way that is mutually advantageous to multiple services. Elefante Group is investing significantly to explore and develop collaborative approaches to spectrum use that enable stratospheric communications systems to operate compatibly in the same spectrum bands as ground-based fixed and mobile radio services and satellite systems, as well as passive services such as earth exploration satellite services, space research, and radio astronomy,.

⁴ *Id.* ¶ 5.

Elefante Group believes that persistent stratospheric-based communications and infrastructure solutions have a critical role to play to fully achieve the Commission's current goals in a timely, cost-effective, and spectrally efficient manner. The advanced wireless broadband networks that are emerging will be heterogeneous and exploit the respective advantages of multiple complementary components, including stratospheric solutions. Persistent stratospheric solutions present operational advantages relative to other delivery methods without the same constraints. Specifically, Elefante Group's stratospheric solution can offer spectrally efficient payloads with frequency reuse higher than satellites and some ground-based systems, but with the latency and greater link data rates comparable to ground-based terrestrial systems. The beam sizes, number of beams and ability to customize the footprint relative to satellites allows Elefante Group's stratospheric solutions to target unserved and underserved areas with micro precision. Elefante Group's stratospheric platforms will have larger potential service areas than ground system base stations with minimal infrastructure requirements and without the potential obstacles arising from base station antenna siting. Further, over that service area, stratospheric-based systems can be maintained, repaired, upgraded, and replaced as part of regular, periodic platform switchover in a matter of months, rather than the years it would take to replace the equipment and technologies supported by other infrastructure. As a result, serviceable stratospheric payloads can ensure equipment throughout a platform footprint remains "state of the art" and responsive to customer needs. Finally, in contrast with ground-based communications systems and with possible advantages over satellite systems, stratospheric platform communications will support rapid deployment and restoration of communications capabilities at high capacities after natural and man-made disasters, enhancing public safety and disaster relief efforts.

As described herein, Elefante Group advocates that the Commission move forward with actions to adopt allocations and rules, as necessary, to support stratospheric communications systems in the bands between 17.8 and 24.0 GHz. If it fails to accommodate access by persistent stratospheric communications systems to adequate and appropriate frequencies, the Commission will run the risk depriving providers, and more importantly, consumers at all levels, with a key pillar of tomorrow's wireless broadband solutions. This is particularly the case because stratospheric platform communications systems present the prospect for tremendous gains in spectrum efficiency and capacity while operating on a highly compatible basis with incumbent uses in already encumbered spectrum. Accordingly, Elefante Group submits that the Commission should take action in the near future to accommodate communications payloads on stratospheric systems in appropriate spectrum bands. Elefante Group appreciates the opportunity to share its views on bands below 24 GHz that it believes would best accommodate its systems and business plans.

II. ELEFANTE GROUP BACKGROUND AND BUSINESS MISSION

Elefante Group, Inc., a United States corporation founded in 2015, aspires to be the world leader in persistent stratospheric-based communications infrastructure. Drawing closely on Lockheed Martin's many decades of expertise and experience with lighter-than-air platforms and communications systems,⁵ the Elefante Group airship platforms and communications payloads are being designed, developed, and will be eventually manufactured and deployed, to support high-density, high-frequency re-use terrestrial broadband communications and Internet of Things

⁵ For example, Elefante Group and Lockheed Martin are developing systems that are a continuation of the scientific and technological advances that Lockheed Martin first demonstrated through its HALE-D and Aerostat projects.

(“IoT”)-enabling solutions for the communications, government, institutional, and enterprise sectors.

Elefante Group’s persistent stratospheric platform solutions, which Elefante Group plans to operate on a wholesale, private carrier basis to other providers, will make possible:

- high-speed broadband connectivity to residences and businesses with cost and performance advantages over other solutions, including fiber connections, which have middle mile requirements that drive high subscription rates;
- ultra-high capacity broadband connectivity to establish secure private lines and networks for enterprises to reduce total cost of network ownership;
- wireless carrier backhaul for connecting small cells to network infrastructure to meet network densification needs of 5G with many advantages over alternatives; and
- IoT-enabling applications combining sensing and communications capabilities for control, location, aggregation, processing and packaging of data across large and/or remote geographic areas to meet the projected growth in IoT devices and increased data usage.

Elefante Group and Lockheed Martin continue to refine an innovative design that possesses exceptional flexibility and yields superior capacity while maximizing spectrum efficiency and frequency band utilization by a variety of users, including accommodation of the communication requirements of incumbents.⁶ Elefante Group is targeting full commercial operations in the United States commencing within the next four years subject to obtaining the spectrum access rights and other regulatory approvals that will be required. Elefante Group’s platform-enabled solutions will advance the achievement of numerous high-priority objectives of the Commission, including:

- private investment in high speed broadband communications infrastructure;⁷

⁶ See Notice ¶ 40 (Commission requesting comment on “recent or upcoming technological developments that may present similar opportunities for spectrum between 3.7 and 24 GHz to be used more flexibly while accommodating the communication requirements of incumbents.”).

⁷ In almost all cases, provided Elefante Group has access to adequate spectrum, as described herein, a single Elefante Group platform operating below 20 km will provide

- closing the digital divide by providing “a critical input to operators to deploy new and improved wireless services to rural, remote, and underserved areas of the country;”⁸
- densification and deployment of 4G, 5G, and IoT-enabling technologies;
- maximization of spectrum efficiency and band utilization;
- forward-looking spectrum sharing built upon licensee collaboration;
- rapid deployment/restoration of communications capabilities enhancing public safety and disaster relief such as after the recent hurricanes afflicting the Southeastern and South Central United States, the Virgin Islands, and Puerto Rico – notably, stratospheric platforms operate “above most weather” and can maintain communications capability even if they are located directly over a large magnitude weather event such as a hurricane; and
- the creation of tens of thousands of American jobs in areas such as engineering, construction, and operations.

III. BASIC CHARACTERISTICS OF THE ELEFANTE GROUP DESIGN: PLATFORM AND PAYLOAD CAPABILITIES

Elefante Group’s stratospheric platform is being designed in a progression from a stratospheric pilot to a prototype system to a full operational system. The Elefante Group design benefits from recent breakthroughs in a variety of areas that make a persistent stratospheric communications solution on the scale Elefante Group envisions technically viable for the first time, such as advancements in aerial platforms materials and design, solar technology, antenna technology and waveforms, and battery technologies. Elefante Group’s operating footprint will be up to 70 km radius for communications and a potentially substantially larger radius for IoT enablement (sensing and communications functionalities combined).

geographic coverage and throughput to support service to an entire metro area. Some metro markets, such as the greater New York City area may require multiple stratospheric platforms, although, as explained below, this could be accomplished by geometrical diversity and reusing frequencies within the same spectrum bands.

⁸ See Notice ¶ 6.

Each Elefante Group platform will operate at a specified nominally fixed position for many months at a time, and will be replaced in a seamless fashion when needed for service or upgrades. Elefante Group plans to deploy its platforms at an altitude of approximately 19.5 km. Elefante Group and Lockheed Martin have identified this “sweet spot” taking into account the weather conditions at various altitudes based on the analysis of years of atmospheric data and the required service coverage area and projected services capacity. In contrast with higher and lower altitudes, 19.5 km offers optimal airship performance and efficiency. For this reason, Elefante Group platforms’ communications payloads at this optimal altitude will fall outside the regulatory definition of “high altitude platform stations,” or HAPS, which specifies stations operating between 20 and 50 km.⁹ Accordingly, Elefante Group submits that the Commission should look beyond the existing or potential designations by the International Telecommunications Union in establishing spectrum appropriate for stratospheric systems like those of Elefante Group. In any event the United States (and all nations) retain the flexibility to make spectrum available for stratospheric systems within their borders without being limited to such designations. For these reasons, Elefante Group, with the technical support of Lockheed Martin, has been examining a large number of candidate spectrum bands.

Elefante Group has modeled the 5G backhaul and fixed broadband access needs and projects that serving these requirements will necessitate flexible deployment of more than 1 Tbps additional capacity per metro area.¹⁰ Consequently, Elefante Group’s system requirements are a

⁹ See 47 C.F.R. § 2.1(c) (definition of “High Altitude Platform Stations”).

¹⁰ Elefante Group’s conclusions about the magnitude of additional requirements are supported by Commission and independent industry assessments. For example, the Commission, in its 2016 *Measuring Broadband America Fixed Broadband Report*, observed that “The median speed across all consumers this year is 39 Mbps which represents a 22% increase to last year’s value of 32 Mbps, indicating that consumer speeds are continuing to increase.” 2016 *Measuring Broadband America Fixed Broadband Report*, at 6(OET and OSPPA, rel. Dec. 1, 2016)

total throughput of 1 Tbps per platform for communications between the platform and user terminals (on a non-oversubscribed basis) at the time of launch of commercial operations with future growth in capacity planned by leveraging a variety of methods. (Feeder links and cross links (i.e., inter-platform links) in other bands will meet other capacity requirements of the platforms and network.¹¹)

available at <http://data.fcc.gov/download/measuring-broadbandamerica/2016/2016-Fixed-Measuring-Broadband-America-Report.pdf> A key capability of the Elefante Group platform systems would be to connect the deluge of expected small cell sites. Wells Fargo research indicates that “Zayo’s management estimated that each national carrier would likely need 150,000 to 400,000 small cell sites each over time, which would equate to 600,000 to 1.6 million in total across the Big 4” mobile carriers. Colin Gibbs, 5G to lift Crown Castle, American Tower, many others: Wells Fargo, FIERCE WIRELESS (June 26, 2017), *available at* <http://www.fiercewireless.com/wireless/5g-to-lift-crown-castle-american-tower-many-others-wells-fargo>. See also, e.g., Iain Gillott, iGR, *New iGR study forecasts a growing number of Mobile Fronthaul and Backhaul Connections for Macrocells and Small Cells to support upcoming 5G*, at 1 (2017) (“While the type of backhaul deployed will vary, we forecast growth in the number of backhaul connections for both macrocells and small cells.”); Kim Laraqui, *et al.*, Ericsson Technology Review, *5G and Fixed Wireless Access* at 3-4 (2016), <https://www.ericsson.com/assets/local/publications/ericsson-technology-review/docs/2016/etr-5g-and-fixed-wireless-access.pdf> (“5G fixed wireless access could also be used to boost existing fixed broadband access in dense urban deployments to achieve higher peak rates. In particular, 5G fixed wireless access appears capable of addressing the bandwidth saturation issue caused by the high demand for typical residential services such as IPTV.”); Broadband Technology Report, *Cell Backhaul: Short Plateau, then Big Growth* at 1 (2015), <http://www.broadbandtechreport.com/articles/2015/10/cell-backhaul-short-plateau-then-big-growth.html> (“Toward 2019, 5G backhaul demand is expected to start to drive the market...”); Daryl Schoolar, *et al.*, Ovum, *5G Fixed Wireless Access*, at 5 (2016), http://www.samsung.com/global/business-images/insights/2016/Whitepaper_5G-Fixed-Wireless-Access-0.pdf (Ovum believes the 5G fixed wireless access opportunities can be divided into two categories. The first category is those markets that already have a high level of fixed broadband but low levels of fiber penetration. Those markets already have the customer base willing to pay for broadband, with 5G fixed wireless access meeting the demand for higher speeds than are currently available to many broadband users. The second opportunity is countries with low overall broadband penetration rates but with a high percentage of those broadband connections being FTTx or having very high FTTx growth rates. Those markets demonstrate a healthy demand for gigabit-speed services, which 5G fixed wireless access can satisfy.”).

¹¹ Elefante Group plans to operate gateways (feeder links between the platforms and global and carrier customer networks) in bands above 24 GHz. The 71-76 and 81-86 GHz bands are the best target bands because of their large bandwidth and availability for Fixed Service point-to-point links, attenuation is better than in surrounding bands, and propagation characteristics will

The Elefante Group platforms will depend principally upon solar power. The platforms will operate persistently at location for an extended period of time. The platforms, once they achieve altitude and reach station, will maintain a nominally fixed position within less than ten kilometers (10 km) in normal operation, allowing for some variation based on local atmospheric conditions. As an operational matter, as necessary for airship or payload maintenance or upgrades, platforms will be replaced by other platforms in a transfer that will avoid disruptions in communications and other functions (e.g., sensing), providing a truly persistent long-term infrastructure and communications solution wherever the platforms are deployed. As a result of the stratospheric-airship architecture, the backbone of an entire communications “network” over a service area within a radius of up to 70 km can effectively be rapidly upgraded as a result of leveraging a regular platform hand-over for service and maintenance reasons.

IV. SPECTRUM REQUIREMENTS TO MEET MARKET GROWTH AND ADVANCE COMMISSION OBJECTIVES

To address industry and marketplace requirements – and advance Commission objectives to close the digital divide and achieve the deployment and densification of 4G, 5G, and IoT-enabling technologies – there will be demand for significant additional baseline communications capacity on a non-oversubscribed basis in many of the markets in the United States over the next few years. As noted above, to help meet these needs, Elefante Group seeks to deploy flexibly more than 1 Tbps additional baseline, non-oversubscribed capacity per metro area at the time of projected initial deployment in a spectrally efficient manner.

allow for multiple feeder links each to each platform. Cross-links may use free space optical communications paths or use higher millimeter wave frequencies.

Based on significant analysis to date by Elefante Group, supported by Lockheed Martin, and their present understanding of how spectrum compatibility can be achieved in the bands they have been examining below 24 GHz, each airship platform will require, in an ideal deployment, use of at least 1.25 gigahertz of spectrum in each direction to support both platform-to-user and user-to-platform communications.¹² This includes at least one gigahertz total bandwidth in each direction for regular operations and at least 250 megahertz bandwidth required for platform handovers to support servicing and upgrades and ensure there is no disruption in service. Further efforts by Elefante Group and Lockheed Martin to achieve compatibility with incumbent systems may indicate the need for consideration of supplemental spectrum from other bands, likely higher than 24 GHz, to achieve performance requirements.¹³

Elefante Group wishes to stress that it and Lockheed Martin have been designing for spectral efficiency and compatibility from the outset.¹⁴ The communications payloads deployed on Elefante Group's stratospheric platforms will rely on advanced waveforms and antennas – which will generate a high degree of frequency reuse within an operating radius of up to 70

¹² These spectrum requirements are independent of the requirements for gateway links. (See note 11, *supra*.) The platforms will also have separate requirements for cross-links and command and control links.

¹³ Elefante Group and Lockheed Martin have been focusing on the development of mitigation techniques relying on frequency planning or agility around existing services. These techniques require sufficient spectrum to forego using parts of it in areas it would cause harmful interference based on local conditions. Elefante Group contemplates non-exclusive licenses for its stratospheric communications and is examining the potential for full compatibility with incumbent services. Under these operating conditions, making more spectrum available to stratospheric communications systems than necessary “in an ideal deployment” would be sound spectrum management by increasing the flexibility of the stratospheric system operator to plan around specific locations depending on the frequencies being utilized by other terrestrial systems or by satellite users.

¹⁴ This compatibility is achieved in large part because of the high-altitude platform geometry, creating directional and spatial diversity relative to incumbent uses, and the small size of the platform's beams which enables considerable flexibility in beam lay-down patterns and a high level of frequency reuse. Elefante Group and Lockheed Martin will rely upon the application of other mitigation methods to enhance compatibility.

kilometers – to achieve a high level of spectrum efficiency.¹⁵ The design of Elefante Group’s system will permit a significant spectrum compatibility with other terrestrial systems, including other stratospheric deployments serving the same geographic areas, as well as the Fixed Satellite Service (“FSS”) and other users of the radio frequency spectrum.

V. CANDIDATE BANDS BELOW 24 GHZ THAT BEST SATISFY ELEFANTE GROUP PERFORMANCE REQUIREMENTS, MAXIMIZE SPECTRUM UTILIZATION, AND HOLD THE PROMISE FOR SPECTRALLY COMPATIBLE OPERATIONS

To achieve the foregoing capacity objectives and corresponding spectrum needs, Elefante Group and Lockheed Martin have been carefully reviewing candidate spectrum bands and selected targeted bands based on an analysis after considering many factors, including the available equipment component base, atmospheric propagation characteristics, prospects for operational compatibility with incumbent and planned uses, and platform and payload size, weight and power (“SWaP”) considerations. The candidate selection analysis also accounts for the fact that the planned stratospheric platform communications fall within the Fixed Services given the persistent operation of the platforms at nominally fixed locations, the fixed location of user ground stations, and the fixed location of gateway terminals.¹⁶ The customer communications provided through the platforms will principally be either between user terminals

¹⁵ Elefante Group and Lockheed Martin are designing communications payloads to reuse each channel in a cellular pattern of spot beams, each only a few kilometers in diameter, as many as 180-to-200 times within the footprint of each platform. The payloads will thus achieve approximately 500 bps/Hz on an aggregate basis across a single platform’s service area.

¹⁶ Elefante Group, with the support of Lockheed Martin, continues to examine what waivers or changes to technical and operational regulations for Fixed Services would be necessary to accommodate its stratospheric platform solutions. For example, promoting broadband deployment using stratospheric systems will benefit tremendously from larger bandwidths than the current Fixed Services rules contemplate. Elefante Group intends to share the results of its consideration of these issues at a future time.

or between user terminals and gateways.¹⁷ The platform stations themselves, maintained at nominally fixed locations, will principally operate as routers and/or relays.¹⁸ (In supporting IoT-enabled solutions, the platforms payloads may include sensors, imaging, and other monitoring devices generating data on board the platforms which is then transmitted to user terminals or the gateway stations.)

Elefante Group, based on considerable technical analyses performed in conjunction with Lockheed Martin, submits that the following spectrum bands under 24 GHz are the most promising to achieve all, or nearly all, of the platforms' communications requirements as part of an initial deployment by Elefante Group.¹⁹

- 17.8-18.3 and 19.3-19.7 GHz would be highly suitable for customer terminal-to-platform links (uplinks). These bands already have primary Fixed Service allocations and service rules. 17.8-18.3 GHz has a secondary non-Federal allocation to FSS (Space-to-Earth) and a co-primary Federal FSS (Space-to-Earth) allocation. 19.2-19.7 GHz has a co-primary FSS allocation (Federal and non-Federal, Space-to-Earth).
- 18.3-19.3 and 19.7-20.2 GHz are also candidate for uplinks. These bands do not have existing Fixed allocations and would require waivers or rule changes to make the spectrum available for Fixed Services use, such as an allocation of Fixed Services, at least for stratospheric systems. The bands are allocated on a primary basis for FSS (Federal and non-Federal, Space-to-Earth). The 18.6-18.8 GHz sub-band is allocated for passive Earth Exploration Satellite Services ("EESS")

¹⁷ Cross-link communications between platforms may also be used, as appropriate, to support the relay of customer communications exchanged between user terminals and the platforms.

¹⁸ As noted earlier, the platform stations will not be operating communications paths during ascent and descent and while *en route* to the nominally fixed station.

¹⁹ In addition, stratospheric deployment of spectrum, whether in conjunction with or in lieu of ground-based terrestrial build-outs, could play a key role in allowing geographic licensees to quickly make use of their spectrum – as an initial deployment or an overlay – and should be an option for such licensees in bands below (as well as above) 24 GHz. In response to the Commission's inquiry in the *Notice* whether it "should grant additional flexibility to incumbent licensees to promote more efficient use of a given band," Elefante Group submits that, where such flexibility does not already exist, granting the ability to deploying spectrum using stratospheric solutions, such as those enabled by Elefante Group platforms, to incumbent licensees through rule changes or waivers would allow them to make much more intensive use of their spectrum by taking advantage of spatial differentiation and self-coordination. *See id.* ¶ 41.

and Space Research Service (“SRS”). 19.7-20.2 GHz is also allocated for Mobile Satellite Services (Space-to-Earth).

- For Platform-to-Customer terminal links (downlinks), 22.5-23.6 GHz is Elefante Group’s primary candidate. The sub-bands in this range already have a primary Fixed Service allocation and service rules. There is also a Mobile Services allocation throughout this range, although no existing rules for non-Federal Mobile operations. There is also a co-primary Inter-Satellite Service allocation at 22.55-23.55 GHz.²⁰

Elefante Group and Lockheed Martin have focused on these bands in the range below 24 GHz as a home for Elefante Group’s platform user communications for a number of reasons.²¹ In general, access to these bands for uplinks and downlinks for stratospheric platforms would maximize technology delivery through potential spectrum access opportunities and suitable propagation losses. More specifically, these candidate bands leverage the existing equipment component base so as to jumpstart communication payload design and development, and have lower atmospheric and weather losses than higher bands. Perhaps most important for purposes of this inquiry proceeding, the work that Elefante Group and Lockheed Martin have done to date indicate that these bands offer the potential for a high degree of spectrum compatibility with incumbent users, be they terrestrial fixed services, FSS operations, ISS operations, EESS, or SRS.

Elefante Group, in a September 8, 2017 *ex parte* notice submission filed in this and other dockets, previously reported to the Commission on the status of the analysis it is conducting with respect to compatibility with services such as Fixed Services, FSS (including both geostationary

²⁰ Elefante Group is also examining the potential use of portions of 22.0-22.5 and/or 23.6-24.0 GHz for the 250 megahertz needed to support operational procedures, in the downlink and/or uplink direction, which would necessitate the development and adoption of acceptable mitigation methods to enable compatible operations on a shared basis with radio astronomy, EESS, and SRS users in the bands depending on location.

²¹ Ongoing analysis and modeling and design efforts may indicate to Elefante Group and Lockheed Martin the need to supplement use of these bands with spectrum from other frequency bands in order to meet Elefante Group’s platform-level performance requirements.

(“GSO”) and non-GSO (“NGSO”) satellite systems), ISS, SRS, and EESS. Elefante Group and Lockheed Martin continue to refine that analysis.²² Elefante Group generally also explained the focus of the further analysis it and Lockheed Martin are conducting in each of the scenarios to confirm results and the effectiveness of interference mitigation methods as well as the development of risk-based interference criteria.

A. Compatibility with Fixed Systems

Beginning with the case of compatible operation with other fixed service systems,²³ frequency planning and resource management should enable a high degree of successful co-band operation.²⁴ Stratospheric systems generally will be able to take advantage of spatial isolation from ground-based services. The elevation angle of communications paths with a stratospheric platform at 19.5 km and an operating radius of 70 km or less will substantially reduce the potential for in-line interference events. This, combined with the antenna gain patterns typical in the 17 GHz-plus frequency bands in question and Elefante Group’s intention to operate within or near power flux density (“PFD”) limits that apply to satellite systems operating in bands shared with Fixed Services, will help ensure compatible operations with ground-based fixed systems. Elefante Group, supported by Lockheed Martin, continues to examine issues such as the scale of

²² See Elefante Group Notice of Oral *Ex Parte* Presentation, GN Docket Nos. 17-183, 14-177, IB Docket Nos. 17-95, 15-256, 97-95, 160408, RM 11-664 and WT Docket No. 10-112, Attachment at 10-16 (Sept. 8, 2017) (“September 8 *Ex Parte*”). Elefante Group incorporates into these comments by cross-reference the September 8 *ex parte* summaries on the work the two companies have undertaken to examine compatibility with other uses in these bands. While mindful of the Commission’s encouragement that parties provide a reference to specific arguments in other pleadings in relevant dockets, rather than re-filing those comments in this proceeding, *see Notice* ¶11, n. 15, Elefante Group believes it important to provide herein a summary of the compatibility studies it and Lockheed Martin have done and continue to refine..

²³ Elefante Group notes that in none of the bands below 24 GHz that it discusses in these Comments are there Commission technical and operational rules for mobile systems, although there are mobile allocations in several of the bands as noted above.

²⁴ See September 8 *Ex Parte*, Attachment at 10, 11, and 13.

any separation distances between transmitter and potential victim receivers that may be recommended as well as risk-based interference analysis of potential interference scenarios between stratospheric system stations and fixed stations using real world operating assumptions.²⁵

B. Compatibility with FSS Systems

With regard to FSS systems authorized or proposed in bands below 24 GHz, Elefante Group has focused on prospective operations in the opposite direction from the satellite systems as a primary method to help manage the potential for harmful interference.²⁶ Thus, for example, in the 17.8-20.2 GHz range, where FSS are permitted to operate, with various priorities, Space-to-Earth downlinks, Elefante Group is looking at operations from end user terminal to stations on the platforms, i.e., uplinks. Elefante Group and Lockheed Martin believe that potential harmful interference to FSS stations can be relegated to controllable geometries. The companies are also evaluating performance impacts using transmitter EIRP pattern and exploring various mitigation approaches to ensure compatibility with current FSS terminals. As in the case of sharing with the Fixed Services, Elefante Group, with Lockheed Martin's assistance, is looking at candidate risk-based harmful interference metrics with the ultimate objective of articulating reasonable and fairly balanced compatibility criteria that support maximum spectrum utilization and efficiency.

Recently, on September 19, Elefante Group filed an *ex parte* submission in the Commission's *NGSO Rulemaking* proceeding in which Elefante Group examined sharing with

²⁵ Elefante Group, supported by Lockheed Martin, anticipates progressing to range and field tests using experimental licenses to confirm the results of their examination of opportunities for compatible operations between stratospheric communications systems and other users, such as "traditional" ground-based fixed systems, satellite systems, and others, as appropriate.

²⁶ See September 8 *Ex Parte*, Attachment at 10-12.

NGSO systems and stratospheric platform systems in more detail.²⁷ Elefante Group explained the importance of earth station power limits, especially off-axis emission limits, to create a predictable operating environment for all platforms, including stations of stratospheric platforms as well as on earth stations on other NGSO systems.²⁸ Although the Commission did not adopt power limits at this time in the order in the *NGSO Report and Order* released on September 27, 2017, Elefante Group intends to continue exploring sharing opportunities with NGSO satellite systems.

Further, Elefante Group notes that if it were to explore co-band operations with NGSO systems *in the same direction*, the availability of NGSO ephemeris data would be an important source of information to better enable compatible operations between the two types of platforms by avoiding in-line interference events.²⁹ Elefante Group incorporates into these comments by reference its September 19 *Ex Parte* to the extent applicable to potential compatible operations between NGSO operations and communications systems stratospheric platforms.

C. Compatibility with Inter-Satellite Service Links

Regarding compatible operation with ISS systems in the 22.55-23.55 GHz band, Elefante Group, supported by Lockheed Martin, continues to examine existing systems and, where needed, consider mitigation methods. Elefante Group does not anticipate that its stratospheric systems will present any interference threat to ISS links. Rather, this is an issue of potential interference into Elefante Group's communications systems, particularly where an ISS architecture involves higher-orbit satellites transmitting to lower-orbit satellites and illuminating

²⁷ See Elefante Group *Ex Parte* Presentation, IB Docket No. 16-408 (Sept. 19, 2017) (September 19 *Ex Parte*).

²⁸ *Id.* at 5-7.

²⁹ *Id.* at 7-8.

portions of the earth. With respect to that scenario, Elefante Group makes reference to its submissions examining compatibility issues and sharing methods with certain ISS proposals in the 22.55-23.55 GHz band of Audacy Corporation.³⁰ In those filings, incorporated herein by reference, Elefante Group explained the potential for various interference mitigation methods to allow Elefante Group and Audacy to efficiently use the same spectrum and allow both systems to utilize the spectrum fully, thereby helping maximize the potential capacity of the band.

D. Compatibility with EESS and SRS

Considerations of compatibility with EESS and SRS are present in the 18.6-18.8 GHz band, which Elefante Group identified above. The work Elefante Group, supported by Lockheed Martin, has done to date demonstrates that the coverage area of an Elefante Group stratospheric platform will present a statistically small effect on satellite-based scanning sensors.³¹ More specifically, within a typical 70 km radius, the coverage area will be in view ~0.0018% of time. The companies are currently modeling the potential aggregate effect of multiple deployed platforms, accounting for the limited periods of time the frequencies in question would be used in connection with any platform station location. Elefante Group, supported by Lockheed Martin, continues to assess the level of any compatibility impacts from use of frequency over the entire platform coverage area, using higher elevation links toward center of area, and short-term platform handover.³²

³⁰ See Comments of Elefante Group, File No. SAT-LOIA-20161115-00117 (filed June 26, 2017) and Reply of Elefante Group, File No. SAT-LOIA-20161115-00117 (filed July 14, 2017).

³¹ In the 22.21-22.5 GHz range, SRS and EESS are not entitled to protection from the Fixed Services. See U.S. Table of Frequency Allocations, 47 C.F.R. 2.106, US532. Nevertheless, Elefante Group intends to examine whether the mitigation methods employed elsewhere to protect these services generally can likely be deployed in this sub-band as well without materially compromising performance of the Elefante Group stratospheric platform systems.

³² The companies are also developing detailed user terminal uplink models as well as bi-static models to consider impacts to EESS and SRS, if any, from reflections of platform-to-user terminal downlinks. *Id.*

E. Compatibility among Co-Band Stratospheric Communications Systems

As a final note, Elefante Group, supported by Lockheed Martin, is confident multiple stratospheric platform systems will be able to reuse the same spectrum in a given geographic area, maximizing spectrum utilization even further. The companies' studies show that stratospheric platform systems can achieve a high level of spectrum compatibility with other co-band stratospheric system deployments using spatial diversity. Separating platforms using the same frequencies by less than the operating radius of the platforms will allow for a complete reuse of the same spectrum, while maintaining compatibility with other users as described above.³³ (Other methods, not solely based on stratospheric platform separation, may exist for sharing the same spectrum among stratospheric systems, as required, on a more dynamic basis.)

* * *

Elefante Group, supported by Lockheed Martin, will continue to build upon their current spectrum compatibility analyses. The companies intend to provide additional status reports to the Commission on their efforts in the coming months, providing more details for their proposals. Elefante Group also intends that they will be reaching out to incumbent users – both commercial and non-commercial, including government, to work collaboratively toward sharing solutions and interference mitigation measures that meet each party's objectives.

VI. CONCLUSION

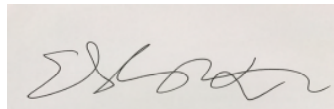
For the foregoing reasons, the Commission should take steps to ensure that next generation networks can achieve their full potential and maximize the benefits of the spectrum for consumers, businesses, enterprises, institutions, and government alike. Stratospheric

³³ Therefore, Elefante Group stratospheric airships will not require exclusive access to spectrum among co-primary users, even among stratospheric platforms. Therefore, the sort of mutual exclusivity that might trigger consideration of spectrum auctions will not be present.

solutions will be a critical component of enhanced 4G and 5G networks as well as roll out of pervasive IoT-solutions in an era of connected machines and devices. In order to promote and facilitate this future and achieve the potential of the spectrum between 3.7 and 24 GHz for innovative wireless broadband opportunities, the Commission should take steps to accommodate highly spectrally efficient stratospheric communications systems within the range 17.8-24.0 GHz as described herein.

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